Associating Motion with $\vec{v}$-t Graphs

Part A

#1 A marble rolls uniformly along a horizontal surface away from origin

speed is constant (slope on $\vec{v}$-t graph is horizontal)

need to define which direction is +ve

∴ C (if away is +ve)
G (if away is -ve)

#2 Book dropped from rest, 1m above floor. Ref. point is the floor.

- initial speed is 0 m/s
- objects accelerate as they fall
∴ velocity is changing

need to define direction of motion as +ve or -ve.

∴ A (if motion down is +ve)
F (if motion up is +ve)

#3 Ball rolls down ramp. Ball released from rest; down ramp is +ve.

- initial speed is 0 m/s & acceleration occurs
∴ A (motion down is +ve)

#4 Ball thrown straight up. Ground is reference pt.

- object experiences acceleration
- object has initial velocity

} B, E satisfy the criteria so far

if we take up as +ve and, knowing that ball comes to rest at maximum height and then has a -ve velocity on the way down, then only E satisfies the criteria

#5 A ball rolls uniformly, strikes a wall then rebounds

↳ velocity-time graph must have horizontal line

↳ -object goes from +ve velocity to -ve velocity, or the other way around

→ only H satisfies the criteria.

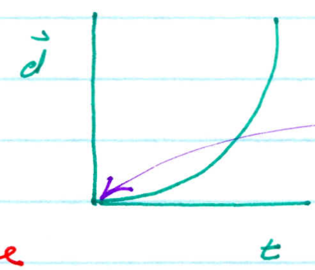
#6 Ball has an initial velocity and then comes to rest.

↳ B, E might be candidates

↳ no graph has $v = 0\,m/s$ at the end.

→ none of the graphs apply.

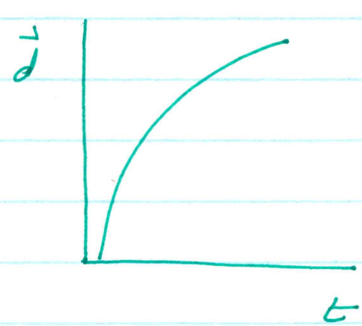
#7 A This graph depicts an object with a +ve acceleration - the $\vec{d}$-t graph must have a curve with increasing +ve slope



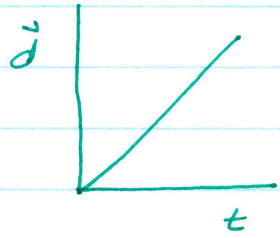
we will assume object started at reference pt.

#7B This graph depicts an object with a -ve acceleration; the object's velocity always remains positive — the $\vec{d}$-t graph must have of curve with decreasing slope

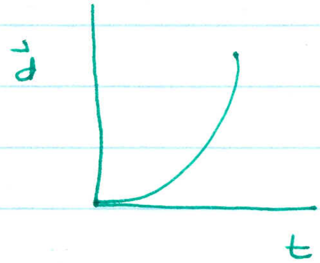
↳ object is slowing down



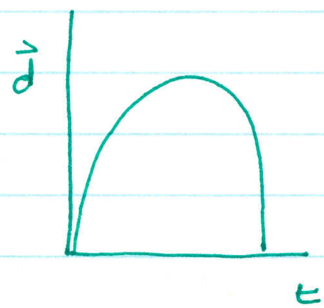
#7C This graph depict an object with a constant +ve velocity.
∴ Object moves in +ve direction and slope of $\vec{d}$-t graph must be constant



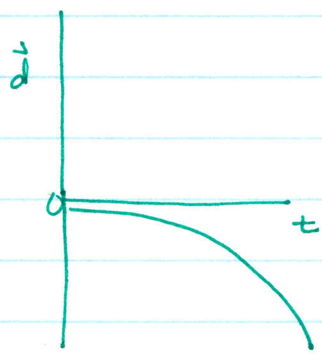
#7D This object has a ~~constant~~ positive, changing acceleration. It's velocity is becoming increasingly more +ve → ~~position~~ $\Delta\vec{d}$ is always +ve



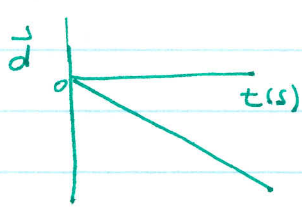
#7E This object has a period of time while it is moving in positive direction albeit slowing down. It comes to rest and then picks up speed in the -ve direction. (comes back towards origin)



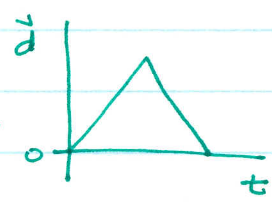
#7F According to the graph, the object starts from rest and is accelerating in the -ve direction while also moving in the negative direction. Same as 7A, just inverted.



#7G Same as 7C except motion occurs in -ve direction.



#7H A combination of C + G.



#8 $Area_1$ $t=0 \rightarrow t=4s$ $\Delta\vec{d} = l \times w = -8\,m\,[R]$ uniform motion

$Area_2$ $t=4s \rightarrow t=14s$ $\Delta\vec{d} = l \times w = +30m\,[R]$ uniform motion

$Area_3$ $t=14s \rightarrow t=30s$ $\Delta\vec{d} = l \times w = +24m\,[R]$ uniform motion

$Area_4$ $t=30s \rightarrow t=42s$ $\Delta\vec{d} = l \times w = -12m\,[R]$ uniform motion

$Area_5$ $t=42s \rightarrow t=48s$ $\Delta\vec{d} = l \times w = +18m\,[R]$ uniform motion

from t=48s to t=60s, the motion is non-uniform → take smaller areas to define the curve

$Area_6$ $t=48s \rightarrow t=52s$ $\Delta\vec{d} = \frac{1}{2}b(h_1+h_2) = +9m\,[R]$

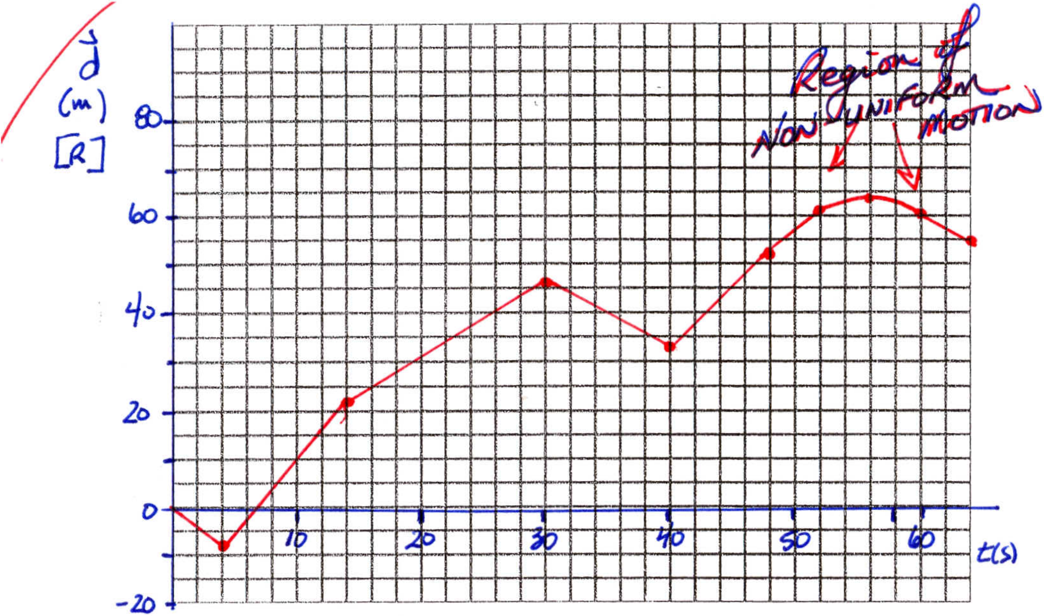
$Area_7$ $t=52s \rightarrow t=56s$ $\Delta\vec{d} = \frac{1}{2}bh = +3m\,[R]$

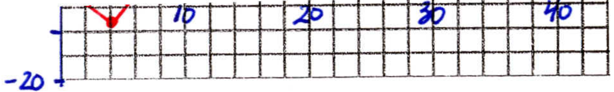
$Area_8$ $t=56s \rightarrow t=60s$ $\Delta\vec{d} = \frac{1}{2}bh = -3m\,[R]$

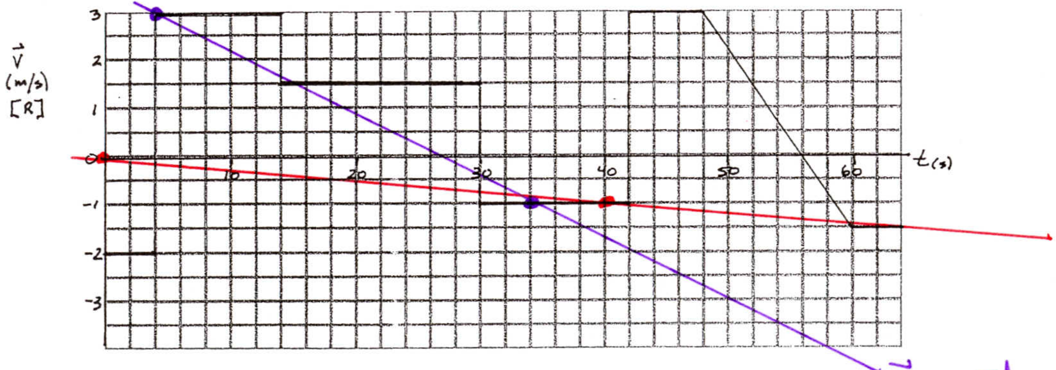
$Area_9$ $t=60s \rightarrow t=64s$ $\Delta\vec{d} = l \times w = -6m\,[R]$ uniform motion

t(s)	$\vec{d}$(m)[R]
0	0
4	-8
14	22
30	46
42	34
48	52
52	61
56	64
60	61
64	55

Area is cummulative!


d (m) [R]
80
60
40
20
0
-20
10
20
30
40
50
60
t(s)
Region of NON UNIFORM MOTION





$$\vec{a}_{avg} = \text{slope} = \frac{(-1-0)}{(40-0)} = -0.025\ m/s^2\ [R]$$

$$\vec{a}_{avg} = \text{slope} = \frac{(-1-3)}{(34-4)} = \frac{-4}{30} = -0.10\ m/s^2\ [R]$$